

Amendments to the Claims:

This listing of claims will replace all prior versions and listing of claims in the application.

Listing of Claims:

1. (Canceled)

2. (Previously Presented) The method of controlling a storage system according to claim 3, wherein the step of controlling by the third storage device to store the first differential management table comprises the steps of:

controlling by the third storage device to compare time set in a data write request received from the first storage device with the first time; and

controlling by the third storage device to store the write history of the data in the first differential management table when the write time set in the data write request received from the first storage device is later than the first time.

3. (Previously Presented) A method of controlling a storage system comprising a first storage device having a first storage volume provided at a first site, a second storage device having a second storage volume provided at a second site, and a third storage device having a third storage volume provided at a third site, wherein the method includes the steps of:

storing a copy of data stored in the first storage volume in the second storage volume with an asynchronous remote copy procedure;

writing the copy of data written in the first storage volume into the third storage volume with a synchronous copy procedure;

relating data written in the first storage volume after a first time to a storage area of the first storage device;

controlling by the third storage device to store []a first differential management table on which a write history of the data written in the first storage volume is recorded after the first time and a second differential management table on which a write history of the data written in the first storage volume is recorded after a second time subsequent to the first time;

transferring data related to the storage area of the first storage device from the first storage device to the second storage device with the asynchronous remote copy procedure after the second time; and

controlling by the third storage device to make contents of the data stored in the second storage volume consistent with contents of the data stored in the third storage volume by using the first differential management table and the third storage volume of the third storage device, if the first site has a disaster.

4. (Canceled)

5. (Previously Presented) The storage system according to claim 6, wherein :
the third storage device compares time set in a data write request received from the first storage device with the first time; and
the third storage device stores the write history of the data in the first differential management table when the write time set in the data write request received from the first storage device is later than the first time.

6. (Previously Presented) A storage system comprising a first storage device having a first storage volume provided at a first site, a second storage device having a second storage volume provided at a second site, and a third storage device having a third storage volume provided at a third site, wherein the system comprises:
the first storage device for storing a copy of data stored in the first storage volume in the second storage volume with an asynchronous remote copy procedure;
the first storage device for writing the copy of data written in the first storage volume into the third storage volume with a synchronous copy procedure;
the third storage device for controlling to store a first differential management table on which a plurality of write histories of the data written several times in the first storage volume is recorded after a first time and a second differential management table on which a plurality of write histories of the data written several times in the first storage volume is recorded after a second time subsequent to the first time;

a storage area, in the first storage device, is related to data written in the first storage volume after a first time;

the first storage device for controlling to transfer data related to the storage area of the first storage device from the first storage device to the second storage device with the asynchronous remote copy procedure after the second time; and

the third storage device for making contents of the data stored in the second storage volume consistent with contents of the data stored in the third storage volume by using the first differential management table and the third storage volume of the third storage device in the event of a disaster that affects the first site.

7. (Previously Presented) A storage system, comprising:

a first disk array system, in a primary site, coupled to a host computer and having a plurality of first disk drive units in which data are stored and a first controller which controls to store data sent from said host computer in a primary volume configured by said first disk drive units,

a second disk array system, in a remote site, coupled to said first disk array system and having a plurality of second disk drive units in which data are stored and a second controller which receives data of said primary volume from said first disk array system with an asynchronous remote copy procedure and controls to store data received from said first disk array system in a secondary volume configured by said second disk drive units,

a third disk array system, in a local site, coupled to said first disk array system and having a plurality of third disk drive units in which data are stored and a third controller which receives data of said primary volume from said first disk array system with a synchronous copy procedure and controls to store data received from said first disk array system in a third volume configured by said third disk drive units,

a first area , in said third disk array system, for storing a plurality of write histories of data written several times in the third volume as a first differential management table after a first time; and

a second area , in said third disk array system for storing a plurality of write histories of the data written into the third volume as a second differential management table after a second time subsequent to the first time; and

a third area, in said first disk array system, being related to data written in said primary volume after the first time;

wherein said first disk array system transfers data related to said third area of said first disk array system from said first disk array system to said second disk array system with the asynchronous remote copy procedure after the second time.

8. (Previously Presented) A storage system according to claim 7, wherein the third disk array system makes contents of data stored in the secondary volume consistent with contents of data stored in the third volume by using said first area

and the third volume of said third disk array system in the event of a disaster that affects said primary site.

9. (Previously Presented) A storage system according to claim 7, wherein said synchronous copy procedure is a copy style that said first disk array system sends acknowledge to said host computer after said third disk array system receives first data sent from said first disk array system, if said first disk array system receives said first data sent from said host computer.

10. (Previously Presented) A storage system according to claim 7, wherein said asynchronous remote copy procedure is a copy style that said first disk array system sends acknowledge to said host computer without relation to that said second disk array system receives second data sent from said first disk array system, if said first disk array system receives said second data sent from said host computer.

11. (Previously Presented) A storage system according to claim 7, wherein each of said write histories has information of a position in said third volume, said position in which data are written.

12. (Previously Presented) A storage system according to claim 7, wherein said data transfer from said first disk array system to said second disk array system with said asynchronous remote copy procedure is acted on a periodic basis.

13. (Previously Presented) A storage system according to claim 7, wherein said third disk array system sends data which relates to information stored in at least one of said first area and second area to said second disk array system, if said first disk array system has a disaster.

14. (Previously Presented) A storage system according to claim 7, wherein said synchronous copy procedure is a copy style that said first disk array system sends acknowledge to said host computer after said third disk array system receives first data sent from said first disk array system, if said first disk array system receives said first data sent from said host computer, and

wherein said third disk array system stores said write history of said first data in said first area, if said third disk array system receives said first data sent from said first disk array system.

15. (Previously Presented) A storage system according to claim 7, wherein said third disk array system transfers data related to said write histories after said first time from said third disk array system to said second disk array system, if said

first disk array system has a disaster during transferring data from said first disk array system to said second disk array system with an asynchronous remote copy.

16. (Previously Presented) A storage system according to claim 7, wherein said third disk array system transfers data related to said write histories after said second time from said third disk array system to said second disk array system, if said first disk array system has a disaster after transferring data from said first disk array system to said second disk array system with an asynchronous remote copy.

17. (Previously Presented) A storage system according to claim 7, wherein said third disk array system, by using said first area, can transfer lesser amount of data that needs to be transferred to said second disk array system than all data stored in said third volume, if said first disk array system has a disaster.

18. (Previously Presented) A storage system according to claim 7, wherein said third disk array system can minimize amount of data that needs to be transmitted to said second disk array system by using said first area, if said first disk array system has a disaster.

19. (Previously Presented) A storage system, comprising:

a first disk array system, in a primary site, coupled to a host computer and having a plurality of first disk drive units in which data are stored and a first controller which controls to store data sent from said host computer in a primary volume configured by said first disk drive units,

a second disk array system, in a remote site, coupled to said first disk array system and having a plurality of second disk drive units in which data are stored and a second controller which receives data of said primary volume from said first disk array system with an asynchronous remote copy procedure and controls to store data received from said first disk array system in a secondary volume configured by said second disk drive units,

a third disk array system, in a local site, coupled to said first disk array system and having a plurality of third disk drive units in which data are stored and a third controller which receives data of said primary volume from said first disk array system with a synchronous copy procedure and controls to store data received from said first disk array system in a third volume configured by said third disk drive units,

a first area, in said third disk array system, for storing a plurality of write histories of data written in the third volume several times after a first time; and

a second area, in said third disk array system, for storing a plurality of write histories of data written into the third volume several times after a second time subsequent to the first time; and

a third area, in said first disk array system, is related to data written in said primary volume after the first time;

wherein said first disk array system transfers data, which are related to said third area of said first disk array system and correspond to said write histories in said first area of said third disk array system, from said first disk array system to said second disk array system with the asynchronous remote copy procedure; and

wherein the third disk array system makes contents of data stored in the secondary volume consistent with contents of data stored in the third storage volume by using said first area and the third volume of said third disk array system in the event of a disaster that affects said primary site.

20. (Previously Presented) A storage system according to claim 19, wherein said first area is a bitmap, and said second area is a bitmap.

21. (Previously Presented) A storage system according to claim 19, wherein said synchronous copy procedure is a copy style that said first disk array system sends acknowledge to said host computer after said third disk array system receives first data sent from said first disk array system, if said first disk array system receives said first data sent from said host computer.

22. (Previously Presented) A storage system according to claim 19, wherein said asynchronous remote copy procedure is a copy style that said first disk array system sends acknowledge to said host computer without relation to that said second disk array system receives second data sent from said first disk array system, if said first disk array system receives said second data sent from said host computer.

23. (Previously Presented) A storage system according to claim 19, wherein each of said write histories has information of a position in said third volume, said position in which data are written.

24. (Previously Presented) A storage system according to claim 19, wherein said data transfer from said first disk array system to said second disk array system with said asynchronous remote copy procedure is acted on a periodic basis.

25. (Previously Presented) A storage system according to claim 19, wherein said third disk array system sends data which relates to information stored in at least one of said first area and second area to said second disk array system, if said first disk array system has said disaster.

26. (Previously Presented) A storage system according to claim 19, wherein said synchronous copy procedure is a copy style that said first disk array system sends acknowledge to said host computer after said third disk array system receives first data sent from said first disk array system, if said first disk array system receives said first data sent from said host computer, and

wherein said third disk array system stores said write history of said first data in said first area, if said third disk array system receives said first data sent from said first disk array system.

27. (Previously Presented) A storage system according to claim 19, wherein said third disk array system can minimize amount of data that needs to be transmitted to said second disk array system by using said first area, if said first disk array system has said disaster.

28. (Previously Presented) A storage system according to claim 19, wherein said third disk array system sends data which relates to information stored in at least one of said first area and second area to said second disk array system, if said first disk array system has said disaster.

29. (Previously Presented) A storage system according to claim 19, wherein said third disk array system transfers data related to at least one of said write

histories from said third disk array system to said second disk array system, if said first disk array system has said disaster during transferring data from said first disk array system to said second disk array system with an asynchronous remote copy.

30. (Previously Presented) A storage system according to claim 19, wherein said third disk array system transfers data related to said write histories of said second area of said third disk array system from said third disk array system to said second disk array system, if said first disk array system has said disaster after transferring data from said first disk array system to said second disk array system with an asynchronous remote copy.

31. (Previously Presented) A storage system according to claim 19, wherein said third disk array system, by using said first area, can transfer lesser amount of data that needs to be transferred to said second disk array system than all data stored in said third volume, if said first disk array system has said disaster.

32. (New) A method of controlling a storage system, wherein the storage system comprises a first disk array system including a first storage volume provided at a first site, a second disk array system including a second storage volume provided at a second site, and a third disk array system including a third storage volume provided at a third site, wherein the method includes steps of:

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writing data from a host computer coupled to the first disk array system to the first storage volume;

transmitting the data written to the first storage volume from the first disk array system to the third disk array system synchronously with writing the data from the host computer to the first storage volume, to store the data in the third storage volume;

managing data written to the first storage volume after a first time as data to be transmitted to the second disk array system after a second time, which is subsequent to the first time;

transmitting the data, which are managed as data to be transmitted to the second disk array system after the second time, from the first disk array system to the second disk array system after the second time, to store the data in the second storage volume;

managing differential management tables including a first differential management table and a second differential management table by the third disk array system, wherein storing location information of data written in the third storage volume, which data are written to the first storage volume after the first time and transmitted from the first disk array system to the third disk array system, is recorded on the first differential management table, and storing location information of data written in the third storage volume, which data are written to the first storage volume

after the second time and transmitted from the first disk array system to the third disk array system, is recorded on the second differential management table, and

controlling, by the third disk array system, to transmit a part of data stored in the third storage volume to the second disk array system to store the part of data in the second storage volume by using the differential management tables, if the first site is damaged.

33. (New) A storage system comprising:

a first disk array system, in a primary site, coupled to a host computer, wherein the first disk array system includes a plurality of first disk drive units, in which data are stored, and a first controller, which is configured to store data written from the host computer in a primary volume configured by the first disk drive units;

a second disk array system, in a remote site, coupled to the first disk array system, wherein the second disk array system includes a plurality of second disk drive units, in which data are stored, and a second controller, which is configured to receive data of the primary volume, which data are sent from the first disk array system by an operation of asynchronous remote copy procedure, and store the data received from the first disk array system in a secondary volume configured by the second disk drive units; and

a third disk array system, in a local site, coupled to the first disk array system, wherein the third disk array system includes a plurality of third disk drive units, in

which data are stored, and a third controller, which is configured to receive data of the primary volume, which data are sent from the first disk array system by an operation of synchronous remote copy procedure, and store the data received from the first disk array system in a third volume configured by the third disk drive units,

wherein the third disk array system includes a memory area including a first area for storing location information relating to locations in the third volume, in which locations data written to the primary volume after a first time and sent from the first disk array system to the third disk array system by an operation of the synchronous remote copy procedure are stored, and a second area for storing location information relating to locations in the third volume, in which locations data written to the primary volume after a second time and sent from the first disk array system to the third disk array system by an operation of the synchronous remote copy procedure are stored, wherein the second time is subsequent to the first time, and

wherein the first disk array system is configured to manage data written to the primary volume between the first time and the second time as data to be transmitted from the first disk array system to the second disk array system by an operation of the asynchronous remote copy procedure after the second time.

34. (New) A storage system according to claim 33,

wherein the third disk array system is configured to transmit a part of data stored in the third volume to the second disk array system by using location information stored in the memory area, when the primary site is damaged.

35. (New) A storage system according to claim 34, wherein the third disk array system is configured to select data stored in locations related to the location information stored in the memory area, and transmit selected data to the second disk array system, when the primary site is damaged.

36. (New) A storage system according to claim 33, wherein the third disk array system is configured to clear location information stored in the first area after completion of transmission of the data, which are managed as data to be transmitted to the second disk array system after the second time.

37. (New) A storage system according to claim 33, wherein the third disk array system is configured to transmit a lesser amount of data than all of the data stored in the third volume to the second disk array system by using location information stored in the memory area, if the primary site is damaged.

38. (New) A storage system according to claim 33, wherein the third disk array system is configured to reduce an amount of data, that needs to be transmitted

to the second disk array system, if the primary site is damaged, by using the memory area.

39. (New) A storage system according to claim 33, wherein in each of the first area and the second area of the third disk array system, a bitmap is configured, on which the location information relating to locations in the third volume is recorded.

40. (New) A storage system according to claim 33, wherein in the synchronous remote copy procedure, the first disk array system receives the data written from the host computer to the primary volume, transmits the data to the third disk array system, and sends an acknowledgement to the host computer after the third disk array system receives the data from the first disk array system.

41. (New) A storage system according to claim 33, wherein in the asynchronous remote copy procedure, the first disk array system receives the data written from the host computer to the primary volume, transmits the data to the second disk array system, and sends an acknowledgement to the host computer regardless of whether the second disk array system receives the data transmitted from the first disk array system.

42. (New) A storage system according to claim 33, wherein after the second time, the first disk array system is configured to transmit the data written to the primary volume between the first time and the second time to the second disk array system, and manage data written to the primary volume after the second time as data to be transmitted from the first disk array system to the second disk array system after completion of transmission of the data written to the primary volume between the first time and the second time.

43. (New) A system for storing data comprising:

a first storage apparatus including a plurality of first disks and a first controller coupled to the plurality of first disks, wherein a first logical volume is configured by the first disks;

a second storage apparatus coupled to the first storage apparatus, wherein the second storage apparatus includes a plurality of second disks and a second controller coupled to the plurality of second disks, and a second logical volume for storing a copy of data stored in the first logical volume is configured by the second disks; and

a third storage apparatus coupled to the first storage apparatus, wherein the third storage apparatus includes a plurality of third disks and a third controller coupled to the plurality of third disks, and a third logical volume for storing a copy of data stored in the first logical volume is configured by the third disks,

wherein when write data to the first logical volume are received at the first storage apparatus, the write data are stored in the first logical volume, transmitted to the second storage apparatus by an operation of asynchronous remote copy procedure to store in the second logical volume, and transmitted to the third storage apparatus by an operation of synchronous remote copy procedure to store in the third logical volume,

wherein the first storage apparatus manages a first group of write data, which are received at the first storage apparatus before a first trigger, as write data to be transmitted to the second storage apparatus by an operation of the asynchronous remote copy procedure, and manages a second group of write data, which are received at the first storage apparatus after the first trigger, as write data to be transmitted to the second storage apparatus by an operation of the asynchronous remote copy procedure after completion of transmission of write data of the first group from the first storage apparatus to the second storage apparatus,

wherein the third storage apparatus records location information including first location information and second location information, wherein the first location information is related to locations in the third volume, in which locations write data of the first group received from the first storage apparatus are stored, and wherein the second location information is related to locations in the third volume, in which write data of the second group received from the first storage apparatus are stored, and

wherein the third storage apparatus clears the first location information after the completion of the transmission of write data of the first group from the first storage apparatus to the second storage apparatus.

44. (New) A system for storing data according to claim 43, wherein the third storage apparatus clears the first location information before transmission of write data of the second group from the first storage apparatus to the second storage apparatus.

45. (New) A system for storing data according to claim 43, wherein the third storage apparatus includes a first bitmap, in which location information including the first location information is recorded, and a second bitmap, in which location information including the second location information is recorded.

46. (New) A system for storing data according to claim 43, wherein when the first site is damaged, the third storage apparatus selects a part of write data of the third logical volume according to the location information, and transmits selected write data to the second storage apparatus to store the selected write data in the second logical volume.

47. (New) A system for storing data according to claim 43, wherein when the first site is damaged, the third storage apparatus selects write data stored in locations specified by using the location information, and transmits selected write data to the second storage apparatus to store the selected write data in the second logical volume.

48. (New) A system for storing data according to claim 43,
wherein after a second trigger after the completion of transmission of write data of the first group from the first storage apparatus to the second storage apparatus, the first storage apparatus manages the second group of write data as write data to be transmitted to the second storage apparatus by an operation of the asynchronous remote copy procedure, and manages a third group of write data, which are received at the first storage apparatus after the second trigger, as write data to be transmitted to the second storage apparatus by an operation of the asynchronous remote copy procedure after completion of transmission of write data of the second group from the first storage apparatus to the second storage apparatus, and

wherein after clearing the first location information, the third storage apparatus records third location information included in the location information, wherein the third location information is related to locations in the third logical volume, in which

locations write data of the third group received from the first storage apparatus are stored.

49. (New) A system for storing data according to claim 48,
wherein the third storage apparatus includes a first bitmap, in which location information including the first location information is recorded, and a second bitmap, in which location information including the second location information is recorded,
wherein the third storage apparatus clears location information recorded in the first bitmap after completion of the transmission of write data of the first group from the first storage apparatus to the second storage apparatus, and before the transmission of write data of the second group from the first storage apparatus to the second storage apparatus, and
wherein the third storage apparatus records the third location information in the first bitmap after clearing the location information recorded in the first bitmap.

50. (New) A system for storing data according to claim 48, wherein the third storage apparatus clears the first location information at a synchronous timing with the second trigger.

51. (New) A system for storing data according to claim 43, wherein the third storage apparatus receives an instruction for clearing the first location information

from the first storage apparatus, and clears the first location information according to the instruction.